

## WAFER STAGING PLATFORM

### Reference to Related Application

5 This application claims the benefit of U.S. Provisional Application No. 60/397,430, filed July 18, 2002.

### Background of the Invention

#### Technical Field

10 The present invention relates to a system, and process for use thereof, for inspecting wafers and other semiconductor or microelectronic substrates.

#### Background Information

15 Over the past several decades, microelectronics and semiconductors have exponentially grown in use and popularity. Microelectronics and semiconductors have in effect revolutionized society by introducing computers, electronic advances, and generally revolutionizing many previously difficult, expensive and/or time consuming mechanical processes into simplistic and quick electronic processes. This boom has been fueled by an insatiable desire by 20 business and individuals for computers and electronics, and more particularly, faster, more advanced computers and electronics whether it be on an assembly line, on test equipment in a lab, on the personal computer at one's desk, or in the home via electronics and toys.

25 The manufacturers of microelectronics and semiconductors have made vast improvements in end product quality, speed and performance as well as in manufacturing process quality, speed and performance. However, there continues to be demand for faster, more reliable and higher performing semiconductors.

30 One process that has evolved over the past decade plus is the microelectronic and semiconductor inspection process. The merit in inspecting microelectronics and semiconductors throughout the manufacturing process is

obvious in that bad wafers may be removed at the various steps rather than processed to completion only to find out a defect exists either by end inspection or by failure during use. In the beginning, wafers and like substrates were manually inspected such as by humans using microscopes. As the process has 5 evolved, many different systems, devices, apparatus, and methods have been developed to automate this process, such as the method developed by August Technology and disclosed in U.S. Patent No. 6,324,298, which is incorporated herein by reference. Many of these automated inspection systems, devices, apparatus, and methods focus on two dimensional inspection, that is inspection 10 of wafers or substrates that are substantially or mostly planar in nature.

To perform such inspection, it is necessary to handle the substrates, such as wafers, to be inspected. While the specific design and layout of the components may vary, a standard layout for a wafer handling system is shown in Figure 1 (prior art) and typically is comprised of the following components: a 15 robot 10, one or more loadports 12, a pre-aligner 14, and a wafer processing platform 16. The robot 10 is used to perform the automated handling. The loadport 12 is used to present a wafer cassette to the system. A wafer cassette or magazine is used to store multiple wafers before and after processing. The pre-aligner 14 is used to center and orientate the wafer for processing by a 20 processing tool, such as an inspection tool, photo-lithography scanner/stepper, or laser repair tool. The wafer processing platform 16 is the stage on which the wafer rests during processing.

Based on the typical standard configuration as set forth in Figure 1, the following scenario demonstrates how wafer handling is performed by a standard 25 wafer handling system. In this scenario, a wafer 20 is currently being processed, and another wafer 22 has been staged on the pre-aligner 14. Figure 2 shows the processing of wafer 20 as complete with the staged wafer 22 on the pre-aligner 14. Figure 3 shows the robot arm 18 extended and the processed wafer 20 removed. Figure 4 shows the robot arm 18 retracted and rotated in a clockwise 30 direction. Figure 5 shows the robot 10 aligned with the wafer 20 in preparation for presentation to a cassette of loadport 12. Figure 6 shows the robot arm 18

extended and the wafer 20 placed in a cassette of loadport 12. Figure 7 shows the robot arm 18 retracted and rotated in a counter clockwise direction. Figure 8 shows the robot 10 aligned with the pre-aligner 14. Figure 9 shows the robot arm 18 extended and the wafer 22 removed. Figure 10 shows the robot arm 18 5 retracted and rotated in a counter clockwise direction. Figure 11 shows the robot 10 aligned with the processing platform 16. Figure 12 shows the robot arm 18 extended and the wafer 22 placed on the processing platform 16. Figure 13 shows the robot arm 18 retracted such that processing of wafer 22 may begin.

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### Summary of the Invention

The handling of semiconductors or like substrates by the present invention significantly reduces transfer time by reducing the swap time of samples as there exists two sample holders placed near the processing platform for at least the purpose of reducing swap time.

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### Brief Description of the Drawings

Preferred embodiments of the invention, illustrative of the best mode in which applicant has contemplated applying the principles, are set forth in the following description and are shown in the drawings and are particularly and 20 distinctly pointed out and set forth in the appended claims.

Figures 1-13 are views of the prior art;

Figure 14 is a top view of the wafer staging platform of the present invention wafer handling system;

Figure 15 is a side view of the wafer staging platform of Figure 14;

25 Figure 16 is a layout view of the overall wafer handling system of the present invention with the wafer staging platform as shown in Figures 14-15 shown therein; and

Figures 17-28 show process views of the present invention.

Similar numerals refer to similar parts throughout the drawings.

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### **Detailed Description of the Preferred Embodiment**

The handling system of the present invention is best shown in Figure 16. In accordance with one of the features of the invention, the handling system includes the novel and unique wafer staging platform 30 as shown best in 5 Figures 14-15 that provides both a staging area for a wafer waiting to be processed, and a temporary location to place a processed wafer while the staged wafer is presented to the processing tool. Figure 16 best illustrates the layout of the wafer handling system of the present invention with this wafer staging platform 30.

10 Other features of the wafer staging platform 30 include a vacuum system including vacuum lines for holding the wafers securely in place, and wafer sensing to allow wafer detecting by the processing tool. Wafer sensing can be performed by either a vacuum sensor or an optical sensor depending on the application.

15 Robotic arm 18 is a two part arm which has two sections, the first of which pivots about a center support and the second of which pivots about the end of the first. Surrounding the robotic arm in one embodiment is the wafer staging platform 30, at least one loadport or cassette receiver 12 (two shown in the Figures), which receives standard wafer transportation cassettes in which 20 multiple wafers are stacked, an optional wafer pre-aligner 14, which would provide a pre-alignment or rough alignment of the wafer, and the wafer processing platform 16.

Wafer processing platform 16 is a rotary stage that is equipped with a universal interface platform with vacuum, all of which provides a flexible 25 interface for wafer and die package fixturing. It is defined such that it quickly mounts and inspects whole wafers, sawn wafers on film frame, die in gel pak, die in waffle-pak, MCM, JEDEC trays, Auer boats, and other wafer and die package arrangements and configurations.

In use, the wafer handling system with the wafer staging platform 30 30 provides the ability to stage and unload wafers in close proximity to the processing platform 16, thereby providing significant time savings in the

transfer. It has been shown that transfer time may be reduced by as much as 80 percent as compared to the system shown and described in Figures 1-13.

One example of a method of handling a wafer is shown in Figures 17-28. Based on the configuration, the following scenario demonstrates wafer handling 5 performed by the present invention including the wafer staging platform 30. In this scenario, a wafer 20 is currently being processed, and another wafer 22 has been staged on the wafer staging platform 30. Figure 17 shows the processing complete with the staged wafer 22 on the wafer staging platform 30. Figure 18 shows the robot arm 18 extended and the processed wafer 20 removed. Figure 10 19 shows the robot arm 18 retracted and rotated in a clockwise direction. Figure 20 shows the robot 10 aligned with the wafer 20 in preparation for presentation to the wafer staging platform 30. Figure 21 shows the robot arm 18 extended to place the wafer 20 on staging platform 30. Figure 22 shows the robot arm 18 retracted. Figure 23 shows the robot 10 aligned with the staged wafer 22. Figure 15 24 shows the robot arm 18 extended and the wafer 22 removed. Figure 25 shows the robot arm 18 retracted and rotated in a counter clockwise direction. Figure 26 shows the robot 10 aligned with the processing platform 16. Figure 27 shows the robot arm 18 extended and placing the wafer 22 on the processing platform 16. Figure 28 shows the robot arm 18 retracted whereby the processing 20 of wafer 22 begins. A wafer can be processed on the processing platform 16 while the robot 10 moves wafers between the loadport(s) 12, the pre-aligner 14, and the wafer staging platform 30.

Accordingly, the invention as described above and understood by one of skill in the art is simplified, provides an effective, safe, inexpensive, and 25 efficient device, system and process, provides for eliminating difficulties encountered with prior devices, systems and processes, and solves problems and obtains new results in the art.

In the foregoing description, certain terms have been used for brevity, 30 clearness and understanding; but no unnecessary limitations are to be implied therefrom beyond the requirement of the prior art, because such terms are used for descriptive purposes and are intended to be broadly construed.

Moreover, the invention's description and illustration is by way of example, and the invention's scope is not limited to the exact details shown or described.

Having now described the features, discoveries and principles of the  
5 invention, the manner in which it is constructed and used, the characteristics of the construction, and the advantageous, new and useful results obtained; the new and useful structures, devices, elements, arrangements, parts and combinations, are set forth in the appended claims.

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